REMARKS

The Office action of August 16, 2006, has been carefully considered.

Claims 1 through 14, 18-19, 21-26, 28-32 and 37-40 have been rejected under 35 U.S.C. 102(b) as anticipated by Clingman et al, while Claim 27 has been rejected under 35 U.S.C. 103(a) as obvious over Clingman et al. Claims 33-36 have been allowed.

The rejection of claims 37-40 over prior art as each of these claims depends directly or indirectly from an allowed claim. It is requested that claims 37-40 be identified as allowed.

It is noted initially that Clingman et al is not directed to a mold or a die component, and does not in any disclose or suggest coating molds or die components. As Clingman et al does not disclose or suggest molds or die components, Applicants submit that those claims which are directed specifically to molds and die components, claims 14, 22-23, and 28-32 cannot be properly rejected an *anticipated* by Clingman et al.

Clingman et al is directed to an abradable ceramic seal coating on at least one of a pair of members having relative rotational movement. Fig. 2 of Clingman et al shows three coating layers on the substrate, a bond coat, an yttria-stabilized zirconium oxide thermal barrier layer, and a porous and abradable yttria-stabilized zirconium oxide layer. The abradable layer is typically formed by co-deposition using a flame spray technique with a polyester powder. After the layer is deposited onto the substrate, the substrate is heated to a temperature of about 1800°F (982°C) for an appropriate period of time to remove the polyester powder, and leave a porous ceramic coating of stabilized zirconia. The purpose of

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this coating is to wear away during rubbing contact with another member. Applicants have previously pointed out that the thickness of this coating is different from the porous layer of the invention, and the Examiner has responded by stating that layer 3' has a thickness which does overlap with the layer of the invention.

Applicants have then argued that layer 3' of Clingman et al, the layer which is of a thickness which overlaps the thickness of the coating of the invention, is not porous. The Office Action now takes the position that this layer is porous, because thermal spraying of a powder results in trapped air, resulting in a porous layer. Applicants strongly disagree.

First, it is noted that the porous layer of the invention is formed by co-deposition, as is the porous, abradable layer of Clingman et al. Layer 3' of Clingman et al is not formed by co-deposition. The Office Action is effectively taking the position that the product-by-process limitation of "co-deposition" of the present claims provides no meaningful difference in the resulting coating, because some porosity results even without co-deposition. However, this clearly not what is being taught by Clingman et al; if there were no meaningful difference, Clingman et al would not bother with two separate layers. Clingman et al does deposit two separate layers because the co-deposited layer has a different, porous structure with different properties. Specifically, the property obtained by co-deposition is abradability, which is desired because the coating of Clingman et al is being formed on members having rotational movement. Similarly, the structure of the co-deposited layer is important to the claimed invention, but for a different reason; the layer of the invention is formed on a mold or die in which it serves as

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a thermal barrier layer.

Thus, the layer 3′ of Clingman et al is both structurally and functionally different from the coating of the invention.

The specification states that "the die coating provided by the invention, because of its porosity, acts as a thermal barrier. In contrast, a non-porous coating of the same material will be less effective as a thermal barrier" (page 5, lines 21-23). When the specification is read as a whole, it is submitted that one of ordinary skill in the art would understand that the term "non-porous" does not necessarily mean having no pores at all, but rather that the effects of porosity are not evident in the physical characteristics of the coating.

It is clear from the Background of the Invention section of the present specification that thermal spraying, including plasma spraying, is a well known means of applying a coating to a substrate. Therefore, reference to a non-porous coating inherently implies that a non-porous coating may be applied by thermal spraying techniques, such as plasma spraying (page 4, lines 1-3). While, technically, plasma spraying may produce some pores in a coating, these pores are relatively few compared to the porosity produced through the process of the invention. Those skilled in the art understand that the term "non-porous" refers to coatings in which the porosity of the coating has not been enhanced, and that the number of pores in the coating has not been increased to provide the physical characteristics of a porous coating.

This implied meaning of "non-porous" is supported by the usage of the term "porous" coating in both the present application and the cited references. Clingman et al clearly relates to a coating in which the porosity of the coating has been controlled, such as with the abradable porous layer (7)

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illustrated in Figure 2 of the reference. As stated previously, Figure 2 of Clingman et al clearly differentiates the porous nature of layer 7 through the illustrations of voids. In comparison, layer 3′ is not labeled as porous, nor is layer 3′ illustrated as containing voids. Thus, in the context of Clingman et al, the illustration of Figure 2 supports the notion that a thermally spray coating layer is considered "inherently non-porous" in contrast to a method which is directed at controlled enhancement of the porosity in the coating layer, such as layer 7.

Furthermore, in describing the abradable coating as porous, Clingman et al inherently teaches away from the use of porous coatings for non-abradable applications such as die coatings, as is discussed on page 4, lines 17 to 23, of the present application. Additionally, Applicants submit that a skilled artisan would consider that layer 3′ in Clingman et al to be a non-porous coating within the context of the reference and the present invention.

Layer 3′ of Clingman et al is applied using equipment and parameters disclosed in US 4,055,705 (column 3, line 30). US 4,055,705 relates to thermal barrier coating systems and discloses that yttria stabilised zirconia is highly *reflective* (column 2, lines 18-19), a parameter not characteristic of a material with significant porosity, since it is generally known that porous structures absorb and trap rather than reflect light. Indeed, for the uses described, the thermal barrier between the high temperature combustion gasses and the air-cooled metal parts predominantly is a radiative barrier (column 2, lines 21-26). The skilled artisan would understand that a key functional characteristic of the coating is a radiative barrier due to the use of the term "reflective" which is a property of radiative barriers, and the high

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temperature gaseous environment to which the coating is exposed.

In contrast, the porous coating of the invention functions primarily as a thermal insulator or conductive barrier (page 5, lines 21-22). Claims 1, 8, 22, 23 and 26-28 have been amended to recite that the porous layer is a thermal barrier.

Radiation is transfer of heat through electromagnetic radiation in the heat spectrum. Hot or cold, all objects radiate heat, unless they are at absolute zero, which is unattainable. No medium is necessary for radiation to occur; radiation works even in and through a perfect vacuum. A prime example of this is heat from the sun which travels through the vacuum of space before warming the earth.

"Shiny" materials typically reflect radiant heat, just as they reflect visible light; dark materials typically absorb heat, just as they absorb visible light. Thermal insulators are materials specifically designed to reduce the flow of heat by limiting conduction, convection, or both. Radiant barriers are materials which reflect radiation and therefore reduce the flow of heat from radiation sources. Good insulators are not necessarily good radiant barriers, and vice versa. Metal, for instance, is an excellent reflector and poor insulator.

The effectiveness of an insulator is indicated by its R-(resistance) value. The R-value of a material is the inverse of the convection coefficient *(k)* multiplied by the thickness *(d)* of the insulator, R = d/k. The units of resistance value are SI units, (Km^2/W).

Rigid fiberglass, a common insulation material, has an R-value of 4 per inch, while poured concrete, a poor insulator, has an R-value of 0.08 per inch.

The effectiveness of a radiant barrier is indicated by

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its reflectivity, which is the fraction of radiation reflected. A material with a high reflectivity has a low emissivity, and vice versa (reflectivity = 1 - emissivity). An ideal radiant barrier would have a reflectivity of 1 and would therefore reflect 100% of incoming radiation.

The functional characteristics of a radiative coating relates to its reflectivity, as stated above. A highly reflective surface is indicative of a coating with inherently low porosity. Indeed, it is an implicit teaching from US 4,055,705 that the coating should be reflective and hence of low inherent porosity to achieve its desired functionality of being an effective radiative barrier. Therefore, it is clear that layer 3' in Clingman et al acts as a thermal barrier due to the reflective surface of the coating and the low thermal conductivity of the stabilized zirconia composition. The inherently low porosity of the coating does not significantly contribute to the thermal barrier properties of the coating.

In contrast, the functional characteristic of the porous coating of the invention is that it functions as a thermal barrier (page 5, lines 21-22). This functionality is achieved through controlled enhancement of the "added" porosity of the coating.

To support the above arguments, an Affidavit of inventor Mahmouz Jahedi has been attached hereto. In commenting on the Clingman et al reference, the inventor states that US 4,055,705, which describes the coating method of Clingman et al, discloses a thermal barrier coating system in which the ceramic coating is highly reflective (column 2, line 19) and that the zirconia stabilized composition of the coatings has low thermal conductivity. The coatings of US 4,055,705 are used in turbine blades and therefore are exposed to high temperature environments in which radiative energy represents

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a significant contribution of the total energy to which the coating is exposed. The coatings also function as a conductive barrier due to the low thermal conductivity of zirconia stabilized compositions. The coating described in US 4,055,705 acts as a thermal barrier due to the reflective ceramic surface acting as a radiative barrier.

The requirement in US 4,055,705 that the ceramic surface be highly reflective indicates inherently that the porosity of the coating is low. Further, the coating of US 4,055,705 is not suitable to function as a coating for a metal die or mold component, as the highly reflective and hence smooth surface is detrimental to the flow of molten metal (see page 10, lines 9-15 of present application).

The inventor thus indicates that the person skilled in the art would consider that the relative porosities of layer 3′ and layer 7 in Clingman et al would be equivalent to the porous and non-porous layers described in the present application, and within the context of the present application, layer 3′ would be considered non-porous, and not a porous thermal barrier layer as required in the amended claims of the present application.

To demonstrate the differences in the thermal conductivity between a coating composition applied with enhanced or added porosity, compared with the porosity inherent in the composition, the affidavit presents test results. The heat transfer coefficient of a coating composition with added porosity, within the scope of the invention was determined, and compared with a coating without the added porosity. The composition according to the invention was labeled "Castcoat with added porosity" and compared with a composition without the initial polymer material. This coating composition was labeled "Thermal Spray

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coating without polymer". The methodology and results of the tests are provided in Exhibit MJ-2, attached to the affidavit.

As illustrated in graph 1 of Exhibit MJ-2, the heat transfer coefficient of the coating with added porosity is significantly less than the heat transfers without porosity. The graph clearly illustrates that the coating with the "added" porosity has superior thermal insulating properties in comparison to the thermal spray coating prepared without the polymer adding porosity.

As discussed in the affidavit, layer 3' of Clingman et al, due to its high reflectivity, has an inherently smooth surface or low surface roughness. This contrasts with the surface roughness of the present invention which is required to enable the molten metal to flow in the die cavity, especially in low pressure and gravity and die casting processes (page 10, lines 4-15). New claims have been added to the application reciting a surface roughness of at least 10 µm. This amendment is supported by page 10, lines 25-28 of the specification, which discloses surface roughnesses of 10 and 25 µm.

To further define the invention, new claims have also been added which recite the porous coating as being the outer surface of the metal mold or die metal component.

As the Clingman et al reference does not disclose or suggest a porous layer of ceramic material having a thickness of about 250 to 400 µm, Applicants submit that the rejected claims are patentable thereover, and withdrawal of these rejections is requested.

In view of the foregoing amendments and remarks, Applicants submit that the present application is now in condition for allowance. An early allowance of the application with amended claims is earnestly solicited.

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Respectfully submitted,

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